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Choosing Fans for Your Livestock Ventilation System

Fans are used in any forced air ventilation system. They may exhaust air from or blow air into a building. In either case, a pressure difference is created between inside and outside the structure. This pressure difference is called static pressure and is measured in inches of water. It can be measured with a manometer (figure 1). A manometer is a water-filled U-tube with one end open to the outside and the other end open to the inside of the building. Exhaust fans develop a negative pressure in a building. That is, the pressure inside is less than the atmospheric pressure outside. For this reason, air enters the building through air inlets (figure 2a). The opposite occurs in a positive pressure system. Here the pressure is greater inside than outside and air exits the building through outlets (figure 2b).

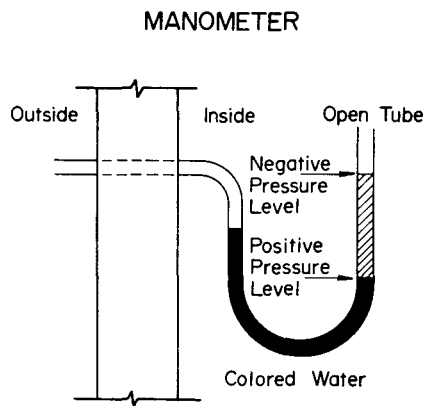

Figure 1. U-tube manometer shows static pressures, the difference in pressure levels between inside and outside for both negative and positive systems.

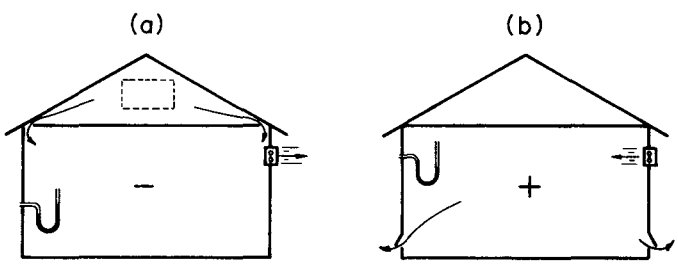

Figure 2. This illustrates operation of a negative pressure ventilation system (a) and a positive pressure ventilation system (b).

MEASUREMENT OF FAN CAPACITY

The amount of air that a fan delivers depends on the diameter of the blades, shape of the fan blades, speed at which the blades turn, horsepower of the driving motor, and design of the shroud and other attachments. All of these components, as well as air inlets and tightness of the building, combine to give fan capacity. Fan capacity is measured by the volume of air (cubic feet) the fan delivers in a given time period (1 minute). The result is the number of cubic feet of air per minute or cfm. This is one criterion for selecting fans for a ventilation system.

FAN RATINGS

The essential criterion in choosing fans for a ventilation system is the static pressures against which the fan will operate. For example, a wind blowing against the wall of a building will increase the static pressure at the wall. An exhaust fan in the wall will deliver less air as the wind velocity increases. This is because the static pressure, against which the fan must operate, increases. If the wind velocity is sufficient, the fan may rotate but may not deliver any air. The static pressure which causes this condition is called "block tight static pressure." Long before the static pressure approaches this value the fan will no longer deliver the desired ventilation air flow. This is shown in table 1 for a given fan. As static pressure increases, the amount of air in cfm that the fan delivers decreases. When the static pressure is zero, the fan is delivering its maximum cfm value—a condition called "free air delivery." Thus, the amount of air a fan delivers depends on what static pressure it operates against. Most ventilation systems operate in the range of 0.05 (5/100) to 0.10 (1/10) of an inch static pressure. Since the system should have a safety factor, you should select fans on the basis of their air delivery (cfm rating) against 1/8 inch static pressure. Table 1 shows this information for a given fan in bold print. If a 2400 cfm fan is needed for a ventilation system, then this would be a good fan to choose since it is rated at or near 2400 cfm at 1/8" static pressure.

Static Pressure	0"	1/10"	**1/8"**	1/4"	3/8"	1/2"	5/8"	4/5"
Cubic Feet Of Air Per Minute (cfm)	2640	2470	**2410**	2080	1870	1720	1600	0

Table 1. This shows cfm rating against different static pressure levels for a particular fan. (The purpose of this table is to show cfm and static pressure relationships for a fan. No endorsement of a particular manufacturer is implied or intended.)

ASSURANCE OF RATING

The rating of fans is not a simple matter; elaborate equipment is needed to do an accurate job. Several procedures for testing fans have been established by the Air Moving and Conditioning Association, Inc. (AMCA). Fan manufacturers may have their fans tested following these standard procedures. If fans are tested the manufacturer may attach an AMCA sticker (figure 3) and certification may be listed in the company's literature. You should look for this certification when purchasing ventilation fans. The AMCA certification gives assurance that the ratings given for the fan are indeed valid. Other fan manufacturers may rate their fans according to other procedures. They may not attach the AMCA sticker but the fans might give satisfactory performance. No matter which fan you purchase, make sure you select a fan that delivers the design capacity in cfm against 1/8" static pressure.

Figure 3. This label indicates that the fan has been tested under a Standard Test Code of the Air Moving and Conditioning Association, Inc. (AMCA).

DIFFERENCE IN FANS

Table 2 shows some typical cfm ratings for different blade diameter fans. You can see that even though several have the same diameter blade, they differ significantly in the cfm air delivery rate. It is particularly important to note that some fans do not even have a cfm rating at 1/8" static pressure. Many fans have only a rating given at 0" static pressure or "free air." Do not select these fans for use in ventilation systems because there is no way of knowing how much air (cfm) they will deliver under operating conditions.

MULTI-SPEED FANS

Generally multi-speed fans are not capable of delivering, when turning at low speed, the desired air capacities against operating static pressures. Low static pressure levels should be avoided since winds and other forces will cause the ventilation system to malfunction. Control over air flow is lost when these states are reached and environmental conditions will suffer. Therefore, two-speed or variable speed fans should not be used in a ventilation system, especially for the fan or fans that operate in the winter. Only single speed fans should be used in a ventilation system. Make sure that sufficient static pressures are maintained for proper operation of the ventilation system.

SUMMARY

Good quality fans are essential for proper performance of a ventilation system. Fans should be selected on the basis of their air delivery in cfm (cubic feet of air per minute) against a 1/8" static pressure. Look for the AMCA certification or other reliable test procedure when purchasing fans to assure valid ratings. Single speed fans are better choices when choosing ventilation fans since they will generally maintain static pressure levels while multi-speed fans will not.

Table 2. Typical Rating Tables for Exhaust Fans*

			Air Delivery in cubic feet per minute (cfm) at indicated static pressure					
DIAMETER	RPM	HP	0"	1/10"	1/8"	1/4"	3/8"	1/2"
8"	1650	1/50	400	316	289	---	---	---
10"	1550	1/50	594	457	413	---	---	---
12"	1550	1/30	730	---	---	---	---	---
12"	1600	1/12	1188	1073	1035	827	---	---
16"	1140	1/12	1675	1440	1374	---	---	---
16"	1725	1/3	2534	2392	2353	2142	1890	1635
18"	1140	1/6	2686	2460	2395	---	---	---
18"	1725	5/8	4065	3920	3880	3682	3445	3195
21"	1140	1/4	3812	3599	3540	---	---	---
21"	1725	3/4	4914	4770	4740	4510	4320	3920
24"	855	1/3	4691	4310	4180	---	---	---
24"	1140	7/8	6254	5990	5920	5470	4810	4220
30"	685	1/2	8112	7555	---	---	---	---
30"	855	1	10125	9700	9575	8640	---	---
36"	570	5/8	10596	9560	9220	---	---	---
42"	490	1	15630	14325	13995	---	---	---

* The purpose of this table is to show variation in performance of fans of different sizes. No endorsement of a particular manufacturer is implied or intended.

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